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Abstract

EXPERIMENTAL BASIS OF POWER REACTOR OPERATION

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Current methods for obtaining essential operational data on power reactors are almost entirely empirical or semi-empirical in nature because of the present inadequacies of purely theoretical methods of physics calculation. Consequently it has been necessary on the first U.K. civil power reactors at Bradwell and Berkeley to repeat many of the measurements performed on the U.K.A.E.A. reactors at Calder and Chapelcross. The main purpose of all the measurements is to provide data which can be used to define the method of operation which achieves the highest efficiency and output consistent with the assurance that the reactor can be controlled and shut down in all credible fault conditions without the safety margin on any component being exceeded. The paper is mainly confined to a discussion of parameters which determine the net reactivity of these reactors, and to the relevance of kinetic experiments.

The assessment of control rod calibration as a function of irradiation and temperature provides a scale for measuring other reactivity parameters, such as the change in reactivity due to the formation of plutonium and fission products, the total temperature poisoning arising from fuel and moderator temperature coefficients of reactivity and reactivity taken up by absorbers. A comparison of the results with theoretical calculations leads to an assessment of the error in applying such methods to the prediction of operational data concerning such problems as fuel cycles and shut-down capacity. In general it is shown that the combination of experiment and theory can satisfy operational requirements within the necessary limits.

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Kinetic experiments are described which have satisfied four main objectives: to confirm the validity of theoretical models used to calculate the consequences of certain credible fault conditions, from which operational limits on such parameters as fuel element temperature and shut-down capacity under fault conditions can be defined; to measure the response of reactors to small perturbations likely to arise in practise; to confirm the model used for stability studies; to calibrate control rods.